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Instrument for plasma coagulation

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## DESCRIPTION

The invention relates to an instrument for plasma coagulation according to the precharacterizing clause of Claim 1.

Such an instrument is known for example from the document EP-  
15 1293170, and in the following is explained with reference to the enclosed Fig. 3.

In Fig. 3 a probe for coagulation of tissue by means of plasma, specifically by means of argon (APC), is shown as a longitudinal section through the end section of the probe,  
20 which during an operation projects out of the opening of the working channel of an endoscope. Argon gas flows through the lumen 11 of a probe body 10 and emerges from an outlet 12 of the probe body 10.

Within the lumen 11 of the probe body 10 is an ignition  
25 electrode 20 that comprises, at its end opposite to a tip 21, a helical section 6 coiled in such a way that the outer circumference of the helix 6 is apposed firmly to a tube wall 13 of the probe body 10, or is fixedly attached thereto. The end of the helical section 6 opposite to the ignition electrode  
30 20 is connected by way of a crimp tubule 7 to a current conductor 25 for supplying a coagulation current. The ignition electrode 20 is situated in the interior of a tubule 14 that is made of ceramic and likewise is firmly pressed into the tube wall 13. The arrangement here is such that the ignition

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electrode 20 with its tip 21 is set back by a prespecified amount from the outlet 12 of the tube body 10, or of the tubule 14 situated therein. Furthermore, the ignition electrode 20 occupies a precisely coaxial position within the tubule 14, so that symmetrical relationships are produced when the argon that flows past the ignition electrode 20 and its tip 21 and then emerges through the outlet 12 is ionized by the coagulation current and thus, in the known manner, produces a plasma that coagulates the tissue to be treated.

- 10 The known arrangement raises many problems, with regard in particular to manufacture but also to the operation of the instrument, in particular long-term operation.

First, it is difficult to provide the ignition electrode 20 with a helical section 6 having sufficiently precise construction that when it is pressed into the probe body 10, the ignition electrode 20 and in particular the tip 21 are positioned exactly in the middle, i.e. are coaxial with the tubule 14. Another problem arises in that the distance separating the tip 21 from the outlet 12 of the tubule 14 depends on the depth to which the helix 6 has been pressed in. Even placing the helix 6 in direct contact with the back end of the tubule 14 cannot alleviate this problem, because pressing too firmly would cause a change in position and/or angle of the ignition electrode 20.

- 25 The connection between the current conductor 25 and the electrode 20 by way of the crimp tubule 7 requires much effort to produce, in which respect it should always be kept in mind that the lumen 11 has a very small diameter, in the case of probes a diameter in the lower mm range or even below that.

- 30 Another problem with the known instrument resides in the fact that in particular the helical section 6 and its transition to the straight ignition electrode 20 cause, firstly, a constriction of the space through which the inert gas flows,

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and furthermore in the transition region between the helical section 6 and the interior of the tubule an asymmetry is present, which results in nonuniform gas-flow relationships within the tubule 14. All these asymmetries and constrictions interfere with the plasma generation and in particular result in poor reproducibility of instruments manufactured in series, with regard to their ignition behavior.

In a thermal respect, as well, the known state of the art raises problems. That is, the plasma causes heating and even burning away of the ignition electrode 20, so that the burning behavior, and in particular the ignition behavior of the instrument, changes while it is in use, which in turn makes it necessary to readjust the coagulation current (and/or the amplitude of the applied HF voltage).

It is the objective of the present invention to develop an instrument of the kind cited above further in such a way that, while simplifying the construction and hence manufacturing procedure, an improved reproducibility of the ignition and burning behavior is ensured.

This objective is achieved for an instrument of the kind cited above in that the electrode-fixing device comprises a metal sheet, a wafer or similar flat body, the longitudinal edges of which are fixed to the tube wall so that the device extends substantially diametrically across the lumen, and the ignition electrode is attached to the surface of the device.

This construction in accordance with the invention firstly facilitates fixing of the ignition electrode within the probe body, because there is no longer any need to coil a helical section. Furthermore, because the fixing device is flat, the inert gas that flows by can cool it as well as the ignition electrode attached to it. The fact that the flat body is in contact at its two edges with the tube wall ensures a symmetrical construction, in particular at the transition

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between the flat body, i.e. the section that holds the ignition electrode, and the ignition electrode itself, which in turn produces symmetrical flow relationships and in particular causes no substantial alterations of the lumen of the probe body. It is very simple to press the flat body into the lumen of the probe body, because it is stiff in itself and is not - as a helical structure would be - placed under tension while being inserted, in which case these tensions would have to be compensated during subsequent use, which could cause changes of position.

The current conductor in one embodiment of the invention is integrally connected to the ignition electrode. In this case a tungsten wire can be used, which extends continuously from the ignition electrode over the fixing wafer or other flat fixing device and on to the plug by way of which the current conductor is connected to the electrosurgical instrument.

Alternatively, the current conductor is connected to the ignition electrode by way of the flat body of the fixing device, so that said device, i.e. the means by which the ignition electrode is held within the probe body, replaces the crimp tubule that is necessary in the known arrangement.

The ignition electrode and/or the current conductor are preferably welded to the flat body, i.e. are fixed by a means that is especially secure and simple to carry out. Particularly suitable for this purpose is resistance welding by way of weld points.

In the region of the outlet a tubule made of ceramic or a similar material that is resistant to high temperatures (as is known per se) can be inserted into the lumen, in which case the flat body is disposed at an end of the tubule facing away from the outlet. This embodiment achieves an increased stability of the arrangement. Preferably in this embodiment an abutment is provided between the flat body, i.e. an abutment formed by

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sections of its front end, and the tubule. This simple measure ensures a precise and unequivocally reproducible geometric alignment between the holder of the ignition electrode (i.e., the flat body) and the ceramic tubule that defines the outlet.

- 5 The flat body preferably comprises a concave cutout at its front edge, which faces the outlet. As a result, on one hand a sufficiently large connecting surface between the flat body and the tube wall is ensured, while on the other hand the lumen is kept free of constricting material over a longer section of the  
10 ignition electrode. This is very advantageous particularly when a ceramic tubule is used, against which the flat body abuts. In this case the cutout is situated ahead of the ceramic tubule, with regard to the flow direction of the inert gas, so that especially interference-free and symmetrical flow conditions  
15 within the tubule are ensured.

In the following, preferred embodiments of the invention are described in greater detail with reference to drawings, wherein

Fig. 1 shows a first preferred embodiment of the invention,

20 Fig. 2 shows a second preferred embodiment of the invention, and

Fig. 3 shows an instrument according to the state of the art.

In the following description, the same reference numerals are used for identical parts or parts with identical actions; in  
25 particular, those parts that have already been explained above in relation to Fig. 3 are not specifically explained again.

As is evident in Fig. 1, for fixing the ignition electrode 20 within a fixation region 22 there is provided a flat body 30 with longitudinal edges 31 and 32, which is pressed into the  
30 lumen 11 of the probe body 10 from its outlet 12 in such a way

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that these edges 31, 32 and hence the entire flat body 30 are in firm contact with the tube wall 13 of the probe body 10. To facilitate the pressing-in procedure, the flat body 30 comprises chamfers 37 at its back edge 36, i.e. the end opposite the outlet 12.

Fixation of the ignition electrode 20, which here is integrated with the current conductor 25 as a (tungsten) wire, to the flat body 30 is accomplished by means of weld points 38, which are preferably produced by point-wise resistance welding.

- 10 With the arrangement shown here it is readily conceivable that an exact, concentric arrangement of the ignition electrode 20 and in particular its tip 21 can very easily be achieved in that the flat body 30, preferably made of a sheet of steel or tungsten, is precisely manufactured and the ignition electrode
- 15 20 together with the current conductor 25 is attached by point welding precisely in the middle of the flat body. The concentric orientation of the flat body 30 within the lumen 11 occurs, so to speak, by itself on account of the precisely symmetrical construction of the lumen 11, i.e. the tube wall
- 20 13.

- The embodiment according to Fig. 2 differs from that shown in Fig. 1 in that in the region of the end of the probe body (as is known per se) a ceramic tubule 14 is inserted. The flat body 30 comprises at its front edge 34, which faces the opening 12,
- 25 a cutout section 35 which merges with abutments 33 next to the two longitudinal edges 31, 32. The abutments 33 are dimensioned such that they correspond substantially to the thickness of the tubule 14. This construction ensures on one hand exact and faultlessly reproducible geometric relationships between the
- 30 flat body 30, together with the ignition electrode 20 attached thereto, and the tubule 14, which defines the outlet 12. The distance separating the tip 21 of the ignition electrode 20 from the outlet 12 does not depend on the process of fixing the ignition electrode within the probe body 10; it depends

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entirely on the precision of manufacturing the flat body 30 and fixing the ignition electrode 20 thereto, which can be ensured by using appropriate tools. Insofar, therefore, the contact between the abutment 33 of the flat body 30 and the back edge 15 of the tubule 14 constitutes an essential adjustment criterion.

In addition to the advantages of the flat body 30 described above, in particular with reference to cooling of the ignition electrode 20 (which achieves a better burning-away behavior), the cutout 35 ensures that the interior of the tubule 14 remains free even in its initial (with respect to the direction of gas flow) regions.

List of reference numerals

	6	Helical section
15	7	Crimp tubule
	10	Probe body
	11	Lumen
	12	Outlet
	13	Tube wall
20	14	Tubule
	15	Back wall of tubule
	20	Ignition electrode
	21	Tip
	22	Fixation region
25	25	Current conductor
	30	Flat body
	31	Longitudinal edge
	32	Longitudinal edge
	33	Abutment
30	34	Front edge
	35	Cutout
	36	Back edge
	37	Chamfer
	38	Weld point

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## CLAIMS

- 5 1. Instrument for plasma coagulation (APC), comprising  
a tubular probe body (10) for conducting inert gas through  
a lumen (11) formed by a tube wall (13) of the probe body  
(10),  
an ignition electrode (20) within the lumen (11) and in the  
10 region of an outlet (12) of the probe body (10),  
a current conductor (25) to supply a coagulation current to  
the ignition electrode (20),  
fixing devices (30) to fix the ignition electrode (20) in a  
specified position within the probe body (10),  
15 characterized in that  
the fixing device consists of a sheet of metal, a wafer or  
similar flat body (30), which is fixed by its longitudinal  
edges (31, 32) to the tube wall (13) so that it extends  
substantially diametrically across the lumen (11), and to  
20 which the ignition electrode (20) is attached.
2. Instrument according to Claim 1,  
characterized in that the current conductor (25) is  
connected integrally to the ignition electrode (20).
3. Instrument according to Claim 1,  
25 characterized in that the current conductor (25) is  
connected to the ignition electrode (20) by way of the flat  
body (30).
4. Instrument according to one of the preceding claims,  
characterized in that the ignition electrode (20) and/or  
30 the current conductor (25) are/is welded to the flat body  
(30).



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5. Instrument according to Claim 4,  
characterized in that the welded attachment (38) is  
punctate, formed by means of resistance welding.
6. Instrument according to one of the preceding claims,  
5 characterized in that in the region of the outlet (12) a  
tubule (14) made of ceramic or similar high-temperature-  
resistant material is inserted into the lumen (11) and the  
flat body (30) is disposed at an end (15) of the tubule  
(14) that faces away from the outlet (12).
- 10 7. Instrument according to Claim 6,  
characterized in that the flat body (30) abuts against the  
tubule (14) by way of sections (33) of its front edge (34).
8. Instrument according to one of the preceding claims,  
characterized in that the flat body (30) comprises a  
15 concave cutout (35) at its front edge (34), which faces  
toward the outlet (12).